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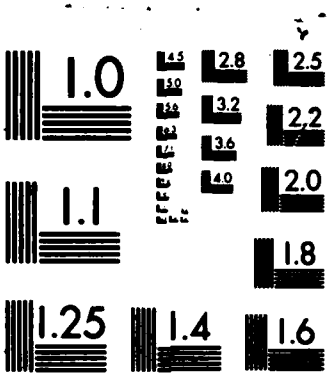

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Four LANDSAT images of cumuliform clouds over polar ocean areas were obtained and analysed to determine the probability of clear (or cloudy) intervals of any length. The probability function was found to be an exponential, similar in form to that found for tropical cumuliform clouds in a previous study.

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A Study of Polar Cloud Populations

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Four LANDSAT MSS computer tapes along with their accompanying photographic products (scale $1:10^6$) were purchased from EOSAT, Sioux Falls, SD. The tapes contain very high resolution imagery (55 m per pixel) of single-layer cumuliform clouds over the Bering Sea and the Gulf of Alaska. Sub-areas (22 km x 33 km) of each Band 4 image were selected for analysis and the cloud/no-cloud brightness value threshold was determined for each. In the accompanying figure each sub-area is presented in its cloud/no-cloud binary form. In the table are given the location and the cloud scene parameters resulting from each sub-area analysis. Regarding the table values, it should be noted that the recurrence interval is the sum of the mean clear and mean cloudy interval lengths and that the cloud cover C, or the clear fraction (1 -C), multiplied by the recurrence interval gives the respective mean interval length.

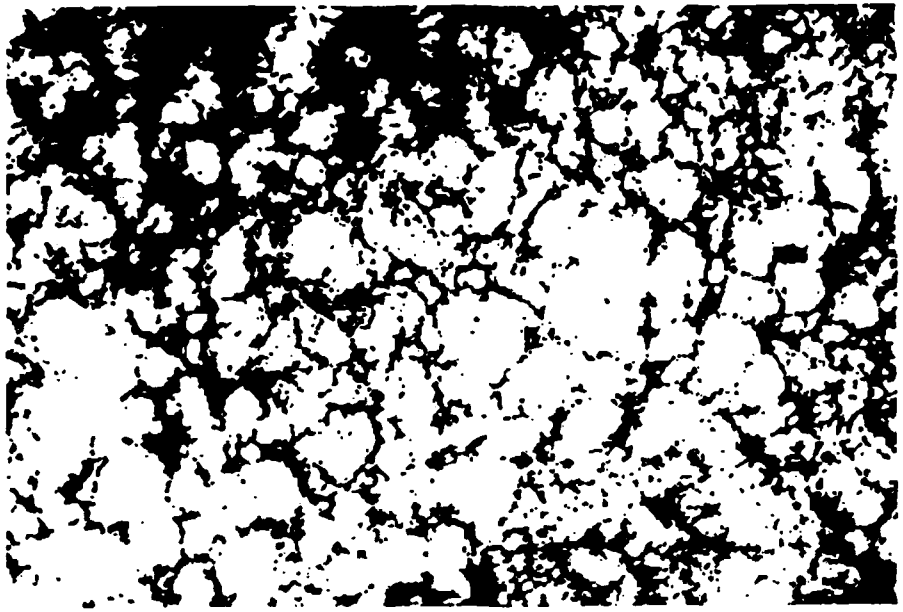
From the analyses of these single-layer polar cloud populations, the probability of intervals (clear or cloudy) of length greater than X_1 is given by

$$P = \int_{X_1}^{\infty} \frac{1}{\overline{X}} \exp\left(- X / \overline{X}\right) dX = \exp\left(- X_1 / \overline{X}\right)$$

where $\overline{X}$ is the mean clear or mean cloudy length depending upon which probability is required. That the probability density, the kernel in the above integral, is a simple exponental function had previously been demonstrated for single-layer tropical clouds (Snow and Willand, 1986) but its more general applicability had been in doubt.

Reference:

Snow, J.W., and J.H. Willand, 1986. Computing Clear Interval Probabilities for Cloud Scences Photographed from the Space Shuttle. In: Presentations at the Fourth Tri-service Clouds Modeling Workshop, Air Force Geophysics Laboratory, Hanscom AFB, MA 184-198.



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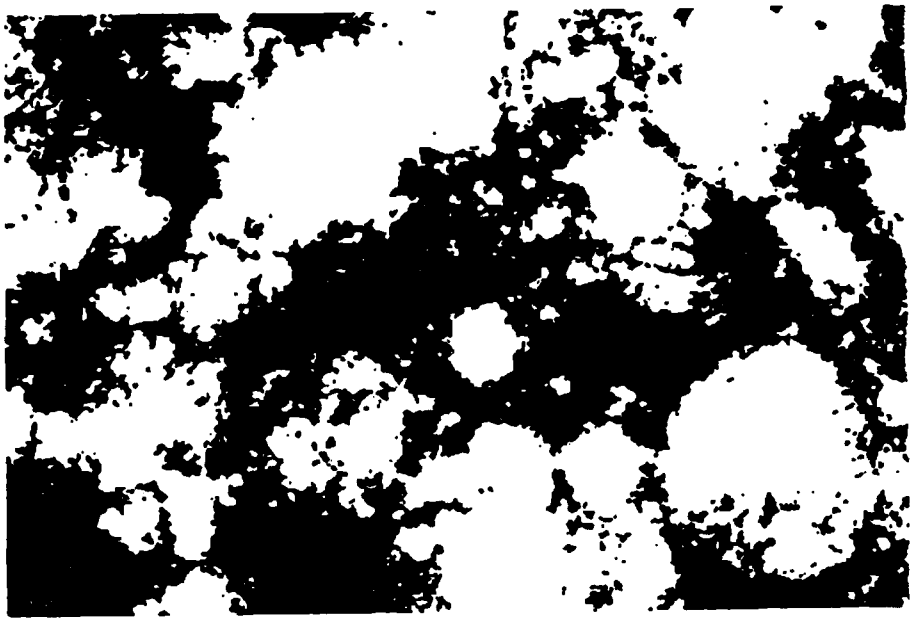

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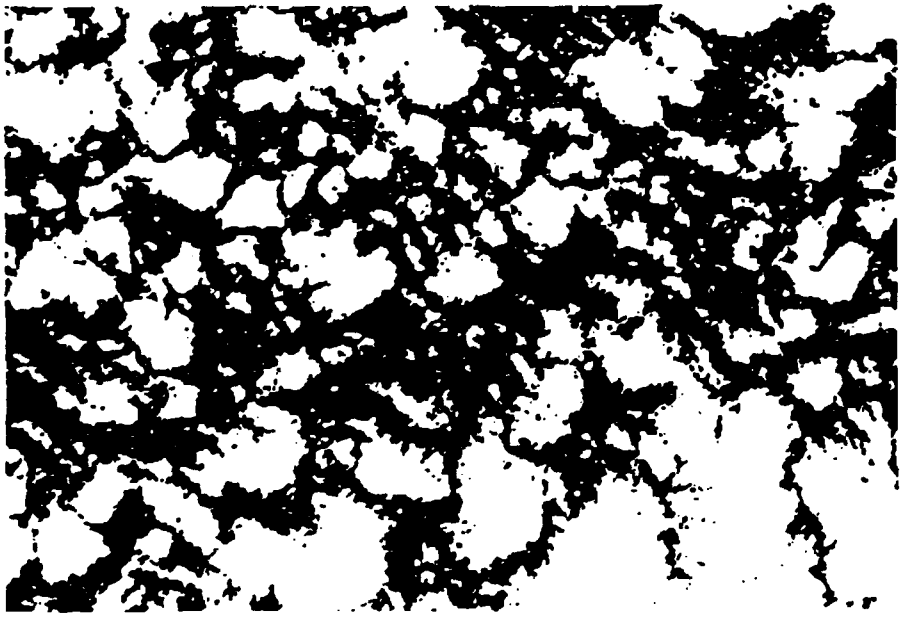

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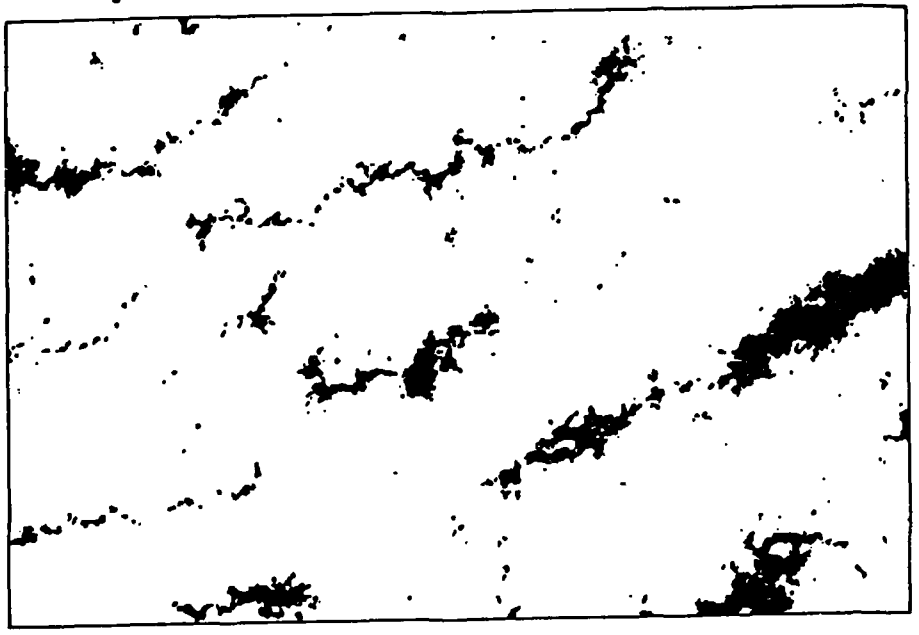

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Binary form of LANDSAT Polar Cloud Scenes. White is cloud, black is no-cloud. Scene size = 22x33 sq km. Scene identification (refer to table) is letter in lower right. All are Band-4 (0.5-0.6 μm). Cloud cover is in percent.

LANDSAT-MSS Polar Cloud Scenes: Date, Location, Cloud Parameters

Scene ID	Exposure Date	Lat. (N)	Long. (W)	Cloud/No-Cloud Threshold*	Cloud Cover	Clear Fractions	Mean Interval Lengths(m) Cloudy	Clear	Recurrence
J4-82205321372X0	05SEP80	58.5	165.3	23	0.647	0.353	823	449	1272
K4-82208921372X0	11OCT80	58.7	165.0	23	0.532	0.468	1340	1180	2520
L4-82197022145X0	14JUN80	62.6	173.0	42	0.532	0.468	894	787	1681
N4-82197022143X0	14JUN80	63.5	172.3	52	0.939	0.061	6157	400	6557

*Pixels with brightness values at or below threshold are clear; greater than threshold are cloudy. Range of threshold values 0 to 128, pixel resolution 55m.

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